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1 RECORD OF ORAL HEARING

2
3 UNITED STATES PATENT AND TRADEMARK OFFICE

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6 BEFORE THE BOARD OF PATENT APPEALS
7 AND INTERFERENCES

8
9
10 Ex parte JOON-SEOP KWAK,
11 KYO-YEOL LEE,
12 JAE-HEE CHO,
13 SU-HEE CHAE

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16 Appeal 2008-4747
17 Application 10/673,251
18 Technology Center 2800

19
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21 Oral Hearing Held: November 18, 2008

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25 Before CHARLES F. WARREN, CATHERINE Q. TIMM, and
26 MICHAEL P. COLAIANNI, Administrative Patent Judges

27
28 ON BEHALF OF THE APPELLANTS:

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1 The above-entitled matter came on for hearing on Tuesday, November
2 18, 2008, commencing at 9:34 a.m., at the U.S. Patent and Trademark
3 Office, 600 Dulany Street, Alexandria, Virginia, before Suzie Dundas,
4 Notary Public.

5
6 MS. BOBO-ALLEN: Calendar No. 43, Appeal Number 2008-4747,
7 Mr. Bowser.

8 JUDGE WARREN: Good afternoon, Mr. Bowser. You have 20
9 minutes. You may fire away.

10 MR. BOWSER: I would like to just concentrate on the independent
11 claims, and the applied references. The Kuwai reference is the primary
12 reference applied against Independent Claims 1, 12, 16 and 23. In that
13 reference --

14 JUDGE TIMM: I'm sorry, Mr. Bowser. Claim 16. Is there any
15 evidence that that is entered as an independent claim? I believe there was an
16 amendment filed with a reply brief.

17 MR. BOWSER: There was an amendment filed prior to the reply
18 brief, and I believe -- I did not bring the communication with me, but there
19 was an order from the Board, asking that the Examiner reply to the
20 Applicant's appeal brief, and I do not know if the Claim 16 was in fact
21 entered. But I am aware that Claim 16, all that was done with Claim 16 was
22 that we rewrote the claim in independent form. Claim 16 depended from
23 Claim 12, so we just rewrote the claim in independent form.

24 JUDGE TIMM: Did you have any arguments with regard to 16 in
25 your initial brief?

1 MR. BOWSER: Not in the initial brief. In the reply brief, it was
2 brought up that Claim 16 includes features that relate to Claims 1 and 23,
3 specifically the dry etching in Step C. The Kuwai reference is the primary
4 reference, and in the Kuwai reference, if you would refer to Figure 11, it's
5 kind of representative of what the disclosure teaches, is that below the
6 sapphire substrate 21, you have --

7 Actually, let me first refer to Figure 10. The sapphire substrate 21, it's
8 wet-etched, and it's wet-etched because these etching masks 34, and it
9 creates the via-hole 35. The disclosure of this patent is rather explicit, in
10 terms of teaching away from a feature of the claimed invention. I would like
11 to refer to specifically Column 2, lines 39 and 44, in which the reference,
12 prior reference discloses that it is actually impossible to make the via-hole
13 with any of these methods.

14 What is referred to with any of these methods is a method described
15 as dry etching by reactive ion etching. Now dry etching and wet etching are
16 two distinct techniques. Wet etching uses an acidic liquid, and dry etching
17 can in one form use gas to remove layers. Also with regard to Column 4,
18 lines 52 and 53, the Kuwai reference says that dry etching, such as
19 conventional RIE, which is reactive ion etching, cannot be employed.

20 JUDGE TIMM: Now when that's talking about conventional RIE,
21 there is a disclosure in Column 2 with regard to GaAs substrates, when you
22 talk about reactive ion etching using a particular (inaudible) to GaAs.
23 Would that be what one (inaudible) with the understanding as being this dry
24 etching by RIE, which is referred to later on in Column 2?

25 MR. BOWSER: Actually, when they refer to the gallium arsenide,
26 they're saying that it can be performed. The reason, the difference here is

1 that sapphire substrates have a different chemical composition. So dry
2 etching can be performed with gallium arsenide, but at the time of this
3 disclosure, it was not believed to be possible to use dry etching with
4 sapphire substrates.

5 JUDGE TIMM: Any sort of dry etching? In the reference, it seems to
6 be referring to a particular dry etching with a particular GaAs, which is
7 different from the substrate that you're using. If you look at Column 2, line
8 19, it refers to GaAs there.

9 MR. BOWSER: Yes. It's disclosing that with gallium arsenide
10 substrates, and then using the GaAs as mentioned in line 4, Column 2, and
11 that it's being used, they're saying that for gallium arsenide, dry etching is
12 possible. But when -- and then specifically with regards to line 37 of
13 Column 2, where it specifically mentions regarding the via-hole to be made
14 in the sapphire substrates, and sapphire is very stable, a chemical property,
15 wet etching cannot be used without any effective etching.

16 It goes on to say "As to dry etching by RIE, since its etching rate is
17 very low, at several micrometers per hour at maximum, and there's no
18 etching mask having a selectively acceptable for selective etching, therefore
19 it's actually impossible the make the via-hole (inaudible)." I believe that
20 paragraph specifically refers to the sapphire substrate, which is what we
21 have in the application.

22 Now in order to -- in an attempt to cure the deficiencies of this
23 reference, the Examiner applied the Nunoue patent. The Nunoue patent,
24 what I'd like to do is refer to Figure 1A, and it teaches dry etching of the
25 sapphire substrate, but it's for a completely different purpose. In the
26 application, the Appellant's application, they're creating a vehicle, a very

1 small vehicle so that they can form a conductive layer to be proximate with
2 the semiconductor layer.

3 Here, on the other hand, what they're doing is just forming this large
4 trench, and that's in Figure 1A, the deep trench, 11A. Then the deep trench
5 is formed, and then after that there's a sequential process where they form all
6 the layers of the semiconductor, the (inaudible).

7 JUDGE WARREN: I'm sorry. You were talking about the fact that
8 they are using the etch to form a particular structure, which is then used for
9 another purpose (inaudible)? Is that your whole point?

10 MR. BOWSER: The point is although this --

11 JUDGE WARREN: So that can't be trenched (inaudible)?

12 MR. BOWSER: No, no, no. Well because actually, in the Nunoue
13 reference, in the Background of the Invention, in Column 1, lines 50 to 59, it
14 mentions about the prospect of dry etching in order to form the via-hole, and
15 it says "It becomes difficult to stop etching with high controllability at the
16 interface between the sapphire substrate and the gallium nitrite
17 semiconductor layer."

18 So the Nunoue reference proposes the idea, but says that it's very
19 difficult. So the Nunoue reference takes a different track. They disclose the
20 use of dry etching in a sapphire substrate, but it's for a completely different
21 purpose. Now considering the teachings of Kawai and Nunoue, I believe
22 that they do not disclose the claimed invention.

23 The Examiner's position is that essentially, that just because Nunoue
24 discloses dry etching for a sapphire substrate, it would have been obvious to
25 modify Kawai. Kawai says that it's impossible, and Nunoue proposes
26 that -- theoretically proposes that this can be done, but it's very difficult, and

1 it takes a different track, an entirely different method of performing or
2 fabricating the light-emitting device.

3 For instance, well let me refer here to Claim 1 and Step C. You're dry
4 etching a region a highly resistant substrate. In Step A of the method, you
5 have formed a first compound semiconductor layer on the high resistant
6 substrate. Now the purpose of Step C is to dry etch a region of the high
7 resistant substrate using a reaction gas comprising at least (inaudible) or
8 boron trichloride to expose the first semiconductor layer.

9 Proceeding in the claim, the first semiconductor layer is already
10 formed on the substrate. Now Nunoue, although it discloses dry etching, it
11 doesn't even attempt to dry etch in order to form the via-hole to get at
12 the -- you know, to expose the first semiconductor layer.

13 For instance, the process of Nunoue, the way this works, is there's a
14 dry etching to form this large, deep trench, and then there's a buffer layer
15 that's inserted on top of the deep trench. Then on top of the buffer layer,
16 there's all the layers of the light-emitting device. Then is a polishing step to
17 reduce the thickness of the substrate. So if you look at Figure 1A, that
18 shows all the layers that are formed in the deep trench.

19 Then if you look at Figure 1B, it shows that the substrate has been
20 polished. The purpose of that is to expose the buffer layer, which is the
21 lower most layer. Then after that, the buffer layer is removed by wet
22 etching. That exposes the lower most layer of the light-emitting via-hole.
23 So the main difference is that neither reference discloses the feature of dry
24 etching a region in the substrate, using the recited gases to expose the first
25 compound semiconductor layer, which is formed on the substrate.

1 JUDGE TIMM: There is a disclosure in the reference, a forming a
2 via-hole, with regard to Figure 7A.

3 MR. BOWSER: Right. Figure 7A. The way -- okay. Figure 7A, that
4 is what's called the tapered contact hole, 62. The tapered contact hole, that's
5 formed by dry etching. Now that is never -- that is not to expose the first
6 semiconductor layer. If you follow -- if you would allow me to just go
7 through here, all Figure 7A through 7F, I'm going to sequentially go and I'll
8 show you here.

9 The contact hole is formed, and if you look at Figure 7B, then they
10 have a varied semiconductor layer 65. That is inserted into the hole, you
11 know, into the area of the tapered contact hole. Then you have Figure 7C,
12 which shows the barium layer at 65. Then the substrate is inverted; it's
13 flipped upside down, and then all -- then you have a 66 is the buffer layer,
14 and then you start growing the semiconductor layers on top of that.

15 JUDGE TIMM: That might be true, but I think the Examiner's basis
16 for the rejection is relying upon the Kawai reference for method of forming
17 the layers and the etching to that.

18 MR. BOWSER: The Examiner's reliance on Nunoue, I was just
19 responding to your question. The Examiner's reliance is that although -- and
20 he acknowledges that the Kawai reference doesn't disclose the dry etching.
21 He's saying that just because the Nunoue reference discloses dry etching, it
22 would have been obvious to combine this.

23 I don't believe that that's disclosed. One skilled in the art would take a
24 look at, would read this reference, the Kawai reference, and understand that
25 it's impossible to use dry etching, and it cannot be employed. Then there's
26 this reference, the Nunoue reference, which mentions the idea of dry

1 etching, but it's for a completely different purpose. It's not for exposing a
2 layer within the light-emitting diode. You're not etching the substrate in
3 order to expose the layer within the light-emitting diode.

4 JUDGE TIMM: But it does show that it is possible to use dry etching
5 to etch a via-hole in the sapphire substrate?

6 MR. BOWSER: The Nunoue reference talks about etching -- for the
7 purposes of etching to achieve a via-hole. It is -- we're talking about the
8 deep trench which covers --

9 JUDGE TIMM: Well, in Figure 7A, it shows us the via-hole 62, a
10 tapered contact hole. Would you say that that's the same thing as a via-hole?

11 MR. BOWSER: The via-hole 62 is then used, that varied layer, which
12 occupies the space in 62, 65. Then if you refer to Figure 7 --

13 JUDGE TIMM: Well yes. Its use is different. But I guess what I'm
14 asking is does the secondary reference show that it's possible to dry etch a
15 via-hole in that environment, in the Figure 7A environment?

16 MR. BOWSER: I would say no, because the via-hole is
17 actually -- that's just a temporary material that you're using.

18 JUDGE WARREN: Wait. Wouldn't it depend, counselor, on what
19 it's doing on the materials there and the material used to etch, as opposed to
20 whether it's trenched?

21 MR. BOWSER: Well, the premise --

22 JUDGE WARREN: So in other words, what we're really talking
23 about is a material that's in the substrate, and what we're using to etch that
24 material?

25 MR. BOWSER: Correct.

1 JUDGE WARREN: As opposed to what the technical name and what
2 one without any skill in the art would call the resulting structure?

3 MR. BOWSER: Yes. We're talking about what, you know, how we
4 expose the semiconductor layer.

5 JUDGE WARREN: Okay. So you want to etch the sapphire; correct?

6 MR. BOWSER: Yes.

7 JUDGE WARREN: So there's no stop layer that's under the sapphire
8 that would stop the etch?

9 MR. BOWSER: There's no stop layer?

10 JUDGE WARREN: Stop layer.

11 MR. BOWSER: Well, based on the disclosure of the Nunoue,
12 Column 1 here, and this is what I was saying, is it's difficult to stop etching
13 with high controllability at the interface. What happens, apparently they've
14 investigated this, and if they do use dry etching, what happens is that they
15 begin to destroy the semiconductor layer.

16 What they want to do is just dry etch up to where the semiconductor
17 layer first sits. So what they end up doing is etching into the semiconductor
18 layer. I'm not sure if that answers your question.

19 JUDGE WARREN: No. What I'm saying is the structures you can
20 form in the substrate depend on the material that the substrate is made out of,
21 and what you use to etch that material. So rather than say while they didn't
22 form the via, they formed the trench or whatever, that's fine. But there's
23 something there that permitted them to form that structure. So the question
24 is really the reference teach that you can control the etch in sapphire down to
25 the particular point.

1 MR. BOWSER: Initially, with regard to Figure 7A, there is the 62,
2 the contact hole, which is formed. The purpose of the claimed invention is
3 we're dry etching. This is a method for fabricating. We are dry etching in
4 order to expose the semi --

5 JUDGE WARREN: I understand why you're doing it. I'm
6 understanding you can do it, and what the references teach.

7 MR. BOWSER: What the references teach is wet etching in order to
8 expose the semiconductor layer.

9 JUDGE WARREN: What do they teach with respect to sapphire?

10 MR. BOWSER: That you can form a trench with dry etching.

11 JUDGE WARREN: So in other words, if they form a trench in
12 sapphire, that means that they must control it to some extent so it won't go so
13 far into the sapphire?

14 MR. BOWSER: What the Nunoue reference uses is photoresist
15 patterns that they put on. Like for example in Figure 1A, you have -- like
16 the outside edges which are not etched. There's a photoresist pattern there,
17 and then they can control it to some extent. But based on what the teachings
18 of the reference, it's hard -- it's difficult to control how far you can go into
19 the sapphire substrate. Which is why it hasn't been used to expose a
20 semiconductor layer that's formed on the --

21 JUDGE TIMM: Does the specification talk about how you solve that
22 problem?

23 MR. BOWSER: The specification talks about how the sapphire
24 substrate is an etch-resistant substrate with regard to the gases that are used.
25 I don't -- there wasn't a detailed description as to why they're able to achieve
26 this -- I mean why they're able to control the precise etching. What was

1 disclosed just is a very narrative fashion, this is done, this is -- and there was
2 never explicit disclosure as to how they were able to stop it.

3 But I believe that based on the overall description in the application,
4 it's because they're using sapphire substrate and because they are using the
5 particular gases, and that sapphire is an etch-resistant substrate.

6 So the main point is that even though the Nunoue reference talks
7 about dry etching, one skilled in the art would not be able to take the
8 Nunoue reference and combine it with the Kawai reference, and all of the
9 sudden result in the claimed invention, for several reasons. One is that, as I
10 already explained, the dry etching is performing an entirely region within the
11 substrate. The Nunoue reference also talks about the difficulty -- it raises
12 the difficulty of forming a via-hole using dry etching, and after raising that
13 difficulty, it goes on and achieves the via-holes by a completely different
14 process.

15 So if one skilled in the art were to read these two, you know, these
16 two patents together, I believe that they would reach a different result.
17 Whether it be by using the sapphire substrate of Nunoue, and then forming
18 all the layers of Kawai on top of it within the deep trench; that's probably
19 one modification.

20 But I don't believe that -- essentially, what the Examiner is saying is
21 the Kawai reference is deficient in terms of dry etching, in order to expose
22 the semiconductor layer. So he sees a reference which teaches dry etching,
23 but he's not really considering -- so I think, I respectfully submit that he's
24 misapplying the teachings of the reference.

1 JUDGE WARREN: Well, is there something in the dry etch of the
2 sapphire layer that would prevent layering in that trench? Because the etch
3 should just take out the sapphire.

4 MR. BOWSER: Well, the Nunoue reference discloses that it's
5 difficult, in order to just take out the sapphire. They said that it's difficult to
6 stop etching at the interface between the semiconductor layer and the
7 substrate, which is -- they proposed it, but then got a different --

8 JUDGE WARREN: Well, that's a bit of a different gas, correct?

9 MR. BOWSER: They don't mention the gases used. They just talk
10 about, in the Background of the Invention, it just mentions dry etching. It
11 says that it's difficult. I'm referring to Column 1, lines 51 to 59. That's
12 where they talk about dry etching, and there's no mention of the gases that
13 are used.

14 JUDGE WARREN: This is in which reference now?

15 MR. BOWSER: The Nunoue reference.

16 JUDGE WARREN: In 51 and 59?

17 MR. BOWSER: Column 1, yes. Lines 51 and 59, and also the
18 paragraph below that.

19 JUDGE TIMM: I just wonder why wouldn't your invention have the
20 same problem?

21 MR. BOWSER: That disclosure has a specific mention in the
22 specification as to why. I'm unable to answer that question, other than that
23 this is based on a foreign application, and knowing the experience with
24 foreign applicants, they only file applications that they think are
25 commercially viable. So it's an assumption that they are able to achieve the
26 invention that's claimed. So I cannot answer that question.

1 Another point is that the Nunoue reference, when they do dry etch the
2 sapphire substrate, they do it before any of the semiconductor layers are
3 even formed on substrate. So I think that they do that because of the
4 consideration that it's very difficult to control, and they haven't had success
5 with it. So given that teaching, and then also given the teaching in Kawai,
6 where it says it's impossible and it cannot be employed, I don't believe that
7 one skilled in the art would read these two references and arrive at the
8 claimed invention. I think that in fact they teach away from the claimed
9 invention, specifically Claims 1, 16 and 23.

10 First, I submit that there's no reason or motivation to combine the
11 references, as proposed by the Examiner. Two, I believe that the Examiner
12 has misapplied the teachings of the references. As I mentioned before, the
13 Examiner just essentially says "Oh, dry etching, and now I'm going to apply
14 it to Kawai." There's no predictability of any success here, especially based
15 on the teachings of the references.

16 Three, even if you do combine, even if one skilled in the art would
17 combine, the references do not collectively disclose all the claimed, all the
18 recited features. Namely, with regard to Claim 1, they do not disclose dry
19 etching a region using a reaction gas to expose the first compound
20 semiconductor layer, because in Nunoue, the dry etching is formed prior to
21 any layers ever being deposited on the substrate. That's why I believe that
22 the Examiner has not produced a prima facie case of obviousness.

23 Secondly, with respect to Claim 12, Step D is forming a
24 light-transmitting conductive layer to cover the exposed region of the first
25 semiconductor layer. Now in terms of the orientation, this would be the
26 bottom layer, the lower-most semiconductor layer. The Examiner agrees

1 that all of the materials for the conductive layers used in both references are
2 not light-transmitting.

3 For example, the Kawai reference discloses chromium and gold and
4 (inaudible), and that's in Column 11, lines 3 to 7, and in another
5 configuration, the lower conductive layer is titanium or aluminum. Now
6 these are all -- you know, none of these are light-transmitting layers. The
7 Examiner raises the issue that it's known to use either light-reflecting or
8 light-transmitting layers. He just says it's known in the art.

9 But that might be true, to use just in isolation. But none of the
10 references disclose using a light-transmitting layer as the lower conductive
11 fill. Namely, Kawai -- those are the materials I mentioned, that's what's
12 disclosed in the Kawai reference. The only reference in the Nunoue patent,
13 as to the orientation of light, and that's with regard to Column 5, line 65 to
14 67, it discloses that the light is emitted upward. It's a top-emitting LED.

15 In the Examiner's answer -- excuse me one second. In the Examiner's
16 answer on page six, the Examiner agrees that all the metallic layers that I
17 mentioned are not light-transmitting layers. But then in his reference to the
18 Nunoue patent, he says that "Prior to forming ohmic electrode 70," now this
19 is with reference to Figure 7E and 7F, "the bearing layer, 65, has a different
20 wide gap materials." Now he refers to Column 8, lines 52 to 62.

21 Now what portion of the reference actually discloses is just that the
22 bearing layer can be made of a conductive or non-conductive material. He
23 gives a few examples, and that it has a lattice constant very close to that of
24 the semiconductor layers in the gallium nitride, the gallium nitrite
25 semiconductor layers. There's no disclosure in this reference that any of
26 those layers are light-transmitting layers, and given the disclosure in Nunoue

1 where it's a top-emitting LED, I don't -- I can't see why you would put a
2 light-transmitting layer below the sapphire substrate, 61. That's just not
3 envisioned in this reference.

4 JUDGE TIMM: Well now, if you were to look at the structure that's
5 formed with that layer 65, would you have the claims -- have something
6 meeting the claim? For instance, if you look at 70.

7 MR. BOWSER: 70 is the N type electrode, and then normally 65 is
8 removed. The only time 65 is not removed is if it's conductive by itself.

9 JUDGE TIMM: But this intermediate product, would that meet the
10 limitations of your claim?

11 MR. BOWSER: If the barium layer is not removed because it's
12 conductive, that's the only time -- because the way the Claim 12 reads is that
13 you're forming this light-transmitting conductive layer to cover the exposed
14 region. There's no mention in the Nunoue reference about it being
15 light-transmitting. It's just talking about conductive or non-conductive. If
16 it's conductive, you don't need to add the N electrode because the varied
17 layer can constitute the N electrode.

18 JUDGE TIMM: I think the Examiner's point is that some of those
19 materials are in fact light-transmitting, even if it doesn't disclose that they
20 are light-transmitting.

21 MR. BOWSER: Yes, and that was my interpretation. But I
22 don't -- you know, I've been working on these LED devices a lot, and I can't
23 say definitively, but know that gallium nitride is not typically considered a
24 light-transmitting element. Aluminum nitride is typically not. Aluminum
25 gallium nitride, and then you have another element, which is silicon carbide.
26 These are not generally thought of as light-transmitting layers.

1 JUDGE TIMM: So zinc oxide might be?

2 MR. BOWSER: Zinc oxide is usually -- it's an insulative layer. I
3 don't -- of the top of my head, I do not know that -- if it's truly in fact
4 light-transmitting, but I think what the Examiner's doing is he's saying here's
5 some materials, and they must be light-transmitting. But what the purpose
6 of those materials are is to disclose whether they're conductive or not
7 conductive. There's no disclosure as to whether it is in fact
8 light-transmitting or light-blocking.

9 I just do not believe that it's any part of the reference, to talk about, to
10 add a light-transmitting layer (inaudible) because the only disclosure in the
11 embodiment where there is light transmission, it's a top-emitting diode. The
12 reason that's usually formed is because when you have a light-emitting
13 diode, if you see there's a small area there, 68A, and that's so that it can
14 direct the light. That's usually the way a LED operates. So you don't have
15 this non-reflectant structure, something like that, with a non-conductive
16 layer.

17 So for those reasons, and for the reasons in the reply brief and the
18 appeal brief, that we believe that the rejection is insufficient and deserves to
19 be overturned.

20 JUDGE TIMM: No questions.

21 JUDGE COLAIANNI: No questions.

22 JUDGE WARREN: No questions. Thank you very much.

23 MR. BOWSER: Thank you.

24 Whereupon, the oral hearing was adjourned.

25

26